stants to be determined. This is all the more tantalising, as the variation with age (or with selection) of the skewness of the frequency curve for a given organ is very probably a most important factor in the mathematical treatment of evolution, while it is precisely *human* material which enables us to record the age, too often an unknown quantity in investigations on the lower animals. It must not be supposed, however, that Mr. Porter realises that skewness in the percentiles marks want of normality in the frequency curve. On the contrary, he takes the raw material for the height of 2192 girls aged eight, and fits it, not very accurately, to a normal frequency distribution. Although the measurements better fit a skew than a normal distribution, the divergence from the normal is not very marked, and Mr. Porter writes:

> "It is not necessary to make this comparison at more than one age, or in more than one dimension, for it is known that if one series in a group like that with which we have to deal shows this agreement, the other series will be found to do the same." (p. 290.)

Now the whole point of the measurements, if properly interpreted, is to ascertain the varying degree of skewness with age, *i.e.* the varying amount of divergence from the normal curve. To emphasise this divergence when remarking on his raw material, but to fail to recognise what bearing it has on theory, is typical of the untrained statistician.

As we have seen, the use of percentiles renders Mr. Porter's material of small value for the problem of selection. The same remark again applies in the case of correlation. The ten organs measured would have been most valuable material for the problem of correlation; the percentile results alone being given, nothing can be done. In Chapter ix. Mr. Porter does develop a theory of correlation, which, however, seems to us absolutely erroneous. As he makes it the basis of a scheme for the school physician to testify whether the pupil's strength is equal to the strain put upon it, this want of accurate theoretical knowledge appears doubly unfortunate.

We have ventured to point out these failings in Mr. Porter's work, not because they are peculiar to him—they are characteristic of much work of a statistical kind which is now being turned out in both Europe and America—but rather because they point to a new need, which the public has hardly yet recognised. There has been up to the present time—with the honourable exception of courses of lectures by Dr. Venn in Cambridge—no teaching of statistical theory in England. There is no chair of statistics in any English university, and the Newmarch lectureship at University College, except for the year of its tenancy by Prof. Edgeworth, has been held by economists, and not by mathematically trained statisticians. We want a centre, which shall not only contain a statistical museum, but embrace as well a statistical laboratory and workshop. In such a centre students might not only receive a mathematical training in dealing with raw statistics, but also be exercised in the methods of collecting and tabulating, which must precede mathematical reduction. To such a centre the biologist and anthropometrist could send their measurements to be "fitted," the physicist his observations to be dealt with, and the economist or sociologist his price or labour statistics to be analysed. At the same time, absolute measurements might be made bearing on the problems of evolution, disease and national economy. In this manner a number of efficient young statisticians might be trained, who would not only find a life-work ready for them in craniology, zoology, botany, and economics, but who, passing into government departments, census offices and labour bureaus, might remove from us the reproach of a recent continental writer, that nowhere were statistical dilettanti so rampant as in England.

Karl Pearson.

WATER SUPPLY AND WATER-WORKS.

The Principles of Water-works Engineering. By J. H. Tudsbery Turner and A. W. Brightmore. (London: Spon, 1893.)

The Water Supply of Towns. By W. K. Burton. (London: Crosby Lockwood and Son, 1894.)

With the constant growth of population, and the increasing tendency of the population to congregate into large towns, the provision of an ample supply of pure water to towns becomes every year of greater importance; whilst, as the nearer sources of supply become inadequate for the ever-growing demands, a sufficient supply becomes more difficult to obtain, and has to be sought at considerable distances. Accordingly, the subject of water-supply has assumed an enhanced importance within recent years; and till these books appeared, there was a dearth of comprehensive text-books on this branch of engineering. As the sources of water-supply, and the works for its provision and distribution are comprised within very definite limits, both books necessarily traverse much the same ground, and deal with similar classes of works; but, nevertheless, they exhibit differences in arrangement, and in the method of treating the various subjects. Thus, whereas "Water-works Engineering" extends over 420 pages, separated into only eight chapters, and illustrated by one hundred and twenty figures in the text, "The Water Supply of Towns" is subdivided into twenty-two chapters, occupying only 272 pages, somewhat larger in size, but illustrated by two hundred and fifty-seven drawings, several of which are put into forty-three large folding-plates. The first book, moreover, is subdivided into numbered sections, the numbers of which are merely used for reference, and instead of the pages in the index; whilst the various subjects in the second book are clearly indicated by black-letter headings. Altogether, "The Water Supply of Towns" is much better arranged for reference; and though containing slightly less matter, it is much more fully illustrated, is in larger print, and has a somewhat longer index than "Water-works Engineering." Neither book gives a summary of contents at the head of each chapter, which is often serviceable for reference.

In "Water-works Engineering," the sources, measurement, collection, storage, purification, conveyance, and distribution of water, and the maintenance of water-works, are successively dealt with in the eight chapters. The most logical sequence would be to describe in regular order the various processes to which water is subjected, from its source up to its delivery to the consumer.

This has only been partially accomplished in "Water-works Engineering," for, owing to the small number of chapters, such dissimilar subjects as the available rainfall and the gauging of the flow of streams have been put in the same chapter, near the beginning of the book, with water-meters, which latter subject should properly have been dealt with at the end, in connection with consumption and waste. Moreover, impounding reservoirs and dams are grouped with service reservoirs, tanks, and house cisterns; whilst the filtration, purification, and softening of water, are considered before the preliminary process of conveyance from the source of supply by aqueducts and conduits. Though the grouping of dissimilar subjects has been avoided in "The Water-Supply of Towns" by the multiplication of chapters, the natural sequence of processes has not been always maintained; for the chapters on pumping machinery, and the flow of water in conduits and open channels, follow after the chapters on purification; whereas the flow of water is intimately connected with the conveyance of the supply from impounding reservoirs; and purification and softening are more needed for waters pumped out of rivers, or from wells, than for waters impounded in a reservoir in a mountainous uninhabited district. In this book, however, the descriptions of water-meters are given in the chapter on the prevention of waste of water, to which subject they properly belong; and cisterns are referred to in this connection, as well as in relation to distribution.

The most notable difference between these two books consists in the use made of mathematical calculations and formulæ. Prof. Burton rarely introduces any formulæ, contenting himself, in the case of high masonry dams, with diagrams of the theoretical profiles proposed by Prof. Rankine and Mr. Wergmann, in addition to the actual sections of the Vyrnwy dam in Wales, and the Tytam dam at Hong Kong; whilst he refers his readers to Fanning's "Treatise on Hydraulics and Water-works Engineering" for formulæ relating to the flow of water. A less cursory treatment of these important subjects, in relation to water-supply, might reasonably be expected in a book which is stated, on its title-page, to be "a practical treatise for the use of engineers and students of engineering"; but perhaps Prof. Burton exercised a wise discretion in this matter, for in the calculation of the cross-section of a stream, on page 28, he falls into an obvious error in including the depths at both extremities to obtain the average depth. The authors of "Water-works Engineering," on the contrary, incline towards the other extreme, and devote more attention to mathematical solutions than to practical considerations. Some amount of mathematical treatment is unquestionably expedient in dealing with the flow of water and the design of masonry dams; and formulæ based upon experience, together with diagrams, furnish almost indispensable aids in the consideration of these matters, and for their practical application. It is, however, an undue extension of the province of mathematics, in such a treatise, to use them to prove that impalpably fine matter in suspension in water would never fully settle (pp. 266–7), which is a subject for physical experiment; and the result would vary with the nature of the material and its specific gravity. Moreover, considering the uncertainties that exist as to the precise distribution of the pressures over the masonry of a reservoir dam, it appears somewhat superfluous to devote over two pages in calculations proving that wind-pressure against the outer face of a masonry dam has only a very slight influence in modifying the position of the line of resultant pressures, with the reservoir empty, under the exceptional conditions of a high wind blowing up the valley, and the reservoir being empty. The somewhat free use of mathematical processes, and the occasional introduction of the integral calculus, will unfortunately be liable to deter persons, who have not received a regular mathematical training, from consulting "Water-works Engineering"; though the greater part of the book deals clearly and concisely with the practical matters and works relating to this branch of engineering. More frequent references to executed works, by way of illustration, would have added interest to the book, and would have served to exhibit the methods of application of general principles, and their results; but the authors explain in their preface, that they considered descriptions of works outside the scope of their book. Owing doubtless to their having lived in cities supplied from wells and impounding reservoirs, they condemn the quality of river waters in stronger terms than the inhabitants of London, deriving a large proportion of their supply from the Thames, would be prepared to admit as correct. They say: "The quality of river-water is seldom unexceptionable, and is frequently bad. . . . Rivers are generally charged with impurities of vegetable, animal, and mineral origin, to such an extent as to render them frequently a most desirable source of water for irrigation purposes, but not for domestic supply." After this it is only a slight consolation to be told that, "still, by certain processes, even the most unpromising river-water is often rendered generally serviceable," especially as, shortly after, they quote the statement of the Rivers Pollution Commission of 1868, that "there is no river in the United Kingdom long enough to effect the destruction by oxidation of sewage put into it at its source," and add, in conclusion, that "the result of the aëration produced by even the Falls of Niagara is so insignificant as to be insensible so far as regards any purifying effect upon the water."

As the author of "The Water Supply of Towns" is Professor of Sanitary Engineering in the University of Tokyo, he has naturally inserted some matters relating more particularly to Japan, such as, for instance, certain special provisions for the extinction of fires which are very common in Japan, owing to the light construction of the houses, and more especially the probable effects of earthquakes on water-works, and the precautions to be taken against them. Most, however, of these special matters have been relegated to foot-notes and an appendix; whilst some particulars of general interest relating to the Tokyo water-works are given in the text.

Both books contain a fairly complete exposition of the principles relating to the water supply of towns, and a general description of the construction of water-works; and they should both prove valuable to the engineer and the student, in relation to this special branch of engineering. Whilst, however, the engineering student, who has had the advantage of a mathematical and scientific training, will doubtless prefer the more scientific metho exhibited in "The Principles of Water-works Engineering," the practical engineer will obtain fuller information, with less trouble, from the more clearly arranged and better illustrated pages of "The Water Supply of Towns."

HAMILTON'S PATHOLOGY.

A Text-book of Pathology, Systematic and Practical. By D. J. Hamilton, M.B., F.R.C.S.E., F.R.S.E., Professor of Pathology, University of Aberdeen. Vol. ii. Parts 1 and 2. (London: Macmillan and Co., 1894.)

THESE two handsome volumes complete the laborious task which Prof. Hamilton set himself many years ago, of producing a text-book of pathology, which should include not merely morbid anatomy and histology, but should deal also with clinical medicine, and those new but rapidly developing sciences, pathological chemistry, pathological physiology, and bacteriology.

It is true that the many varied problems which come before a pathologist require for their solution a more or less extensive acquaintance with each and all of these branches. So many, however, are the workers, and so vast has the literature become in each branch, that it is already impossible for anyone to be equally proficient in all, and it is necessary to specialise.

If this is the case with the individual, it is much more so with the text-book. It is impossible to compress within even 1800 pages, a tithe of our present knowledge of all these branches, and opinions will differ widely as to how the selection should be made.

The task of making such a selection is herculean enough to daunt any man, and the thanks of all interested in pathology are due to the Professor for the very valuable addition he has made to our literature on the subject. The amount of original work is considerable, and the volumes are copiously illustrated by drawings, the majority of which are by the author.

An extremely useful feature in the book consists in the bibliography of both the English and foreign literature at the end of each section. The convenient system is also adopted of indicating the title of any publication referred to in the text by a number in Roman letters, while the full titles and the corresponding numbers are given in a list at the end of the book. The first volume, which was reviewed in these columns in 1889, met with general appreciation. This volume commenced with full directions for making systematic post-mortem inspections, and for the practical bacteriology and histology of the tissues removed. Nearly 200 pages were devoted to a full account of inflammation and suppuration, and of tumours and new formations, while the remainder of the book was occupied by an account of the heart, the blood, and the vascular system generally.

The two parts of the second volume now issued are bound up separately. The first part of the present volume is devoted to a systematic account of the pathology of the respiratory organs, the liver and the kidney; a good solid piece of work containing much original research, in which are embodied the well-known papers of the author on diseases of the lungs, and on cirrhosis of the liver. Among the many observations, we would draw attention to the important conclusion that in nephritis the fatty granular remains of the convoluted epithelium are absorbed by the lymphatic system, and are not, as is generally supposed, mainly washed out by the urine.

The drawings, illustrating the author's views, are worthy of all praise; they are well executed, and are sufficiently diagrammatic to impress the conclusion to be indicated, while their reproduction also reflects great credit on the publishers.

The remainder of the volume deals with the diseases of the digestive, the nervous, the osseous and the cutaneous systems, finishing with a short statement of the various malformations, and a good summary of systematic bacteriology and of human parasites.

The present volume is overweighted by 150 pages of normal anatomy and physiology, which preface the accounts of the various organs, nearly fifty pages and twenty illustrations being devoted to the nervous system. This material is surely out of place in a book, in which the author has been compelled by the exigencies of space and time to reduce his account of the pathology of many conditions to too brief an account to be of value, so that often there is no indication as to which lesions and causes are common and important to remember, and which are exceptional; frequently a mere list of them is given.

It is also to be regretted that it has been thought desirable to devote valuable space to the description of the various tests for sugar and albumen in the urine, as this information is contained in the ordinary standard books on clinical medicine.

The author apologises for the lapse of five years since the appearance of the first volume; and we cannot help regretting that Prof. Hamilton did not publish only the first part of the present volume, and allow himself another year or more in which to have worked up the second part to the high standard reached in the earlier portion of the book. Although five years may appear a long time, for the production of the second volume of this book, still the amount of labour required was so extreme that more time was really necessary. The lack of space also has necessitated so much compression, that often the pathology is reduced to a mere explanation of the terms used; while the numerous omissions of important facts suggest that this part has been produced at very high pressure, so that the facts are not presented in their due relation to one another, while there are several statements to which we would take exception.

While such common causes of optic neuritis as plumbism and anæmia are omitted, excessively rare ones, such as pneumonia and measles, are given; again, while optic neuritis is discussed, optic atrophy is omitted. Among the causes of cerebral hæmorrhage, such well-recognised ones as glioma and aneurysm are omitted.

Through oversight the following conflicting statements have been allowed to appear. Under cysts of the liver, the association of such with similar ones in the kidney is said to be fortuitous; while under the head of renal diseases, it is noted that out of sixty-two cases of cystic kidneys, seventeen were associated with similar cysts in the liver. On one page, in discussing the growth of typhoid bacilli, great doubt is thrown on whether they spore; on the next page, it is stated that they invariably spore when grown under suitable conditions.